

## REMARKS

This Response is submitted in reply to the final Office Action mailed on May 5, 2011. A petition for a one month extension of time (\$130.00) and a Request for Continued Examination ("RCE") (\$810.00) are submitted herewith. The Director is authorized to charge \$130.00 for the one-month extension of time, \$810.00 for the RCE and any additional fees which may be required, or to credit any overpayment to Deposit Account No. 02-1818. If such a withdrawal is made, please indicate the Attorney Docket No. 3712174-00037 on the account statement.

Claims 26-32 and 35-39 are pending in this application. Claims 1-25 and 33-34 were previously canceled without prejudice or disclaimer. In the Office Action, Claims 26-32 and 35-39 are rejected under 35 U.S.C. §103. In response, Applicants have added Claims 40-41. The new claims do not add new matter. Applicants have submitted herewith an Affidavit under 37 C.F.R. §1.132 ("*Affidavit*") that demonstrates the unexpected results of the present claims and the deficiencies of the prior art with respect to the present claims. For at least the reasons set forth below and in the *Affidavit*, Applicants respectfully submit that the rejections should be withdrawn.

In the Office Action, Claims 26-32 and 35-39 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,772,934 to MacFadden ("*MacFadden*") in view of U.S. Patent No. 6,280,878 B1 to Maruyama et al. ("*Maruyama*"). For at least the reasons set forth below, Applicants respectfully submit that, even if combinable, *MacFadden* and *Maruyama* fail to disclose each and every element of the present claims.

Independent Claim 26 recites, in part, a gel electrolyte secondary cell comprising: a positive electrode; a negative electrode comprising a current collector and a powder mixture composed of a graphite material having a mean particle size of 5 to 100  $\mu\text{m}$ ; and a gel electrolyte comprising an electrolyte salt, a non-aqueous solvent and a high-molecular weight material, wherein the non-aqueous solvent comprises propylene carbonate and ethylene carbonate, wherein a content of propylene carbonate ranges from 10 mol% to 75 mol%, and wherein the graphite material comprises sintered meso-carbon micro-beads.

If a graphite material is used as a negative electrode in a non-aqueous electrolyte cell, propylene is decomposed due to the instability of propylene carbonate against a graphite material, thereby lowering the charging/discharging efficiency. See, Specification, page 2, paragraph 20. As supported by the *Affidavit*, the degree of decomposition of propylene carbonate in a graphite cell varies depending on the physical properties of the graphite material.

See, *Affidavit*, ¶ 5. For example, with respect to the size of the graphite powder particles, the conventional understanding at the time of the invention was that a graphite material having a larger particle size has a smaller surface area and thus is less susceptible to decomposition of propylene carbonate. See, *Affidavit*, ¶ 5. If, however, the graphite material has a small particle size, the decomposition of propylene carbonate is significant. See, *Affidavit*, ¶ 5. If decomposition of propylene carbonate occurs, there is a discharge capacity loss that lowers the charging/discharging efficiency of the battery. See, *Affidavit*, ¶ 5. Therefore, the conventional understanding was that it was desirable to use graphite having a larger particle size in a battery containing a propylene-carbonate based electrolytic solution. See, *Affidavit*, ¶ 5.

However, in a non-aqueous gel electrolyte cell, a graphite material having a smaller particle size is desirable in order to maintain the electron and ion conductivities between the particles of the graphite material in the anode. See, Specification, page 2, paragraphs 22-23. This is because if the particle size is too large, the ion conduction path is increased, thereby increasing the impedance to lower the cell voltage and deteriorating the cell performance. See, Specification, page 2, paragraph 24. The present claims therefore provide a gel electrolyte secondary cell including a graphite material having a mean particle size of 5 to 100  $\mu\text{m}$ , wherein the graphite material comprises sintered meso-carbon micro-beads; and wherein the non-aqueous solvent comprises propylene carbonate. By providing a gel electrolyte including the sintered meso-carbon micro-beads having the claimed size in combination with propylene carbonate, a high ion conductivity can be obtained without substantially decreasing the discharge capacity loss. See, Specification, page 1, paragraph 18; page 2, paragraphs 26-28. In contrast, the cited references are deficient with respect to the present claims.

For example, even if combinable, *MacFadden* and *Maruyama* fail to disclose or suggest a gel electrolyte secondary cell wherein the graphite material comprises sintered meso-carbon micro-beads as recited, in part, by Claim 26. The Patent Office asserts that the phrase “comprises sintered meso-carbon micro-beads” is a product-by-process limitation which should not be given patentable weight “in the absence of unexpected results.” See, Office Action, page 2, lines 13-18. However, as supported by the *Affidavit*, one of ordinary skill in the art would understand that graphite materials exhibit widely varying physical properties based on the starting material and the production process and are therefore distinguishable from each other. See, *Affidavit*, ¶ 4. Specifically, one of ordinary skill in the art would understand that a graphite

material comprising sintered meso-carbon micro-beads is distinguishable from a graphite material comprising fired petroleum coke. See, *Affidavit*, ¶¶ 6-7.

For example, Table 1 of the Specification demonstrates that a gel electrode cell containing a lithium metal foil positive electrode, an electrolyte composed of 35 mol % propylene carbonate and 65 mol % ethylene carbonate, and a negative electrode comprising various graphite materials was evaluated. See, *Affidavit*, ¶ 6. When the graphite negative electrode material was a fired material of meso-carbon micro-beads having a particle size such that the specific surface area is 3.6 m<sup>2</sup>/g and 1.2 m<sup>2</sup>/g, respectively, initial charging/discharging efficiencies of 82.8% and 82.6% were obtained. See, *Affidavit*, ¶ 6; Specification, Table 1. In contrast, when the same cell when the graphite negative electrode material was a fired petroleum coke having a specific surface area of 4.5 m<sup>2</sup>/g, the initial charging/discharging efficiency was significantly lower – 61%. See, *Affidavit*, ¶ 6; Specification, Table 1. One of ordinary skill in the art would thus understand that a graphite material comprising sintered meso-carbon micro-beads having the claimed particle size in accordance with the present claims achieves an unexpectedly high charging/discharging efficiency when combined with propylene carbonate and is thus distinguishable from a graphite material comprising fired petroleum coke. See, *Affidavit*, ¶ 6

As supported by the *Affidavit*, *MacFadden* and *Maruyama* fail teach a graphite material that comprises sintered meso-carbon micro-beads. See, *Affidavit*, ¶¶ 8-9. Instead, *MacFadden* merely discloses a carbon anode active material that may be in the form of graphite generally and fails to specify the particular type of graphite material used in its anode. See, *MacFadden*, column 4, lines 9-13; *Affidavit*, ¶ 8. Similarly, *Maruyama* merely teaches a battery wherein “[t]he carbon used as the active material may be properly selected from natural or artificial graphite” and fails to specify the particular type of graphite used in its battery. See, *Maruyama*, column 5, lines 9-10; *Affidavit*, ¶ 9. As such, even if combinable, *MacFadden* and *Maruyama* fail to disclose or suggest a graphite material comprising sintered meso-carbon micro-beads.

Accordingly, Applicants respectfully request that the rejection of Claims 26-32 and 35-39 under 35 U.S.C. §103(a) to *MacFadden* and *Maruyama* be withdrawn.

In the Office Action, Claims 26-32 and 35-39 were rejected under 35 U.S.C. §103(a) as being unpatentable over *MacFadden* in view of U.S. Patent No. 5,522,127 to Ozaki et al. (“*Ozaki*”). For at least the reasons set forth below, Applicants respectfully submit that, even if

combinable, *MacFadden* and *Ozaki* are deficient with respect to independent Claim 26 and Claims 27-32 and 35-39 that depend therefrom.

For example, even if combinable, *MacFadden* and *Ozaki* fail to disclose or suggest using sintered meso-carbon micro-beads having the claimed size in combination with a solvent containing propylene carbonate as required, in part, by Claim 26. As supported by the *Affidavit*, *MacFadden* merely discloses using graphite in a solid polymer electrolyte cell containing propylene carbonate and fails to teach that the graphite comprises sintered meso-carbon micro-beads. See, *MacFadden*, column 4, lines 9-13; column 5, lines 11-20; *Affidavit*, ¶ 8. *Ozaki* merely discloses a micro-bead based electrode with an electrolyte containing ethylene carbonate, diethyl carbonate and methyl propionate and fails to teach the claimed combination of sintered meso-carbon micro-beads having the claimed size and a solvent containing propylene carbonate. See, *Ozaki*, column 2, lines 66-67; column 3, lines 1-7; column 4, lines 54-58; *Affidavit*, ¶ 10. Instead, pursuant to conventional wisdom, *Ozaki* teaches that propylene carbonate generates unfavorable side reactions with its small-sized graphite particles and therefore should not be used with its graphite particles. See, *Ozaki*, column 7, lines 5-16; *Affidavit*, ¶ 10.

Moreover, a gel electrolyte secondary cell including sintered meso-carbon micro-beads having the claimed size and a solvent containing propylene carbonate would not have been obvious because the claimed combination achieves unexpected results. See, *Affidavit*, ¶¶ 6-7. As demonstrated in Table 1 of the Specification, a coin-shaped gel electrode cell containing a lithium metal foil positive electrode, an electrolyte composed of 35 mol % propylene carbonate and 65 mol % ethylene carbonate, and a negative electrode comprising various graphite materials was evaluated. See, *Affidavit*, ¶ 6. When the graphite negative electrode material was a fired material of meso-carbon micro-beads having a particle size such that the specific surface area is  $3.6 \text{ m}^2/\text{g}$  and  $1.2 \text{ m}^2/\text{g}$ , respectively, initial charging/discharging efficiencies of 82.8% and 82.6% were obtained. See, *Affidavit*, ¶ 6. In contrast, when the same cell was used and the graphite negative electrode material was a fired petroleum coke having a specific surface area of  $4.5 \text{ m}^2/\text{g}$ , the initial charging/discharging efficiency was significantly lower – 61%.

Similarly, Table 2 demonstrates initial charging/discharging efficiencies of 74.5% and 74.1% in a gel electrolyte cell containing propylene carbonate when a graphite material comprised of sintered meso-carbon micro-beads is used as the anode material, whereas a ***significantly lower efficiency of only 56%*** is achieved in the same gel electrolyte cell when the anode material is substituted with a graphite material obtained by firing petroleum coke. See,

*Affidavit*, ¶ 7. As such, one of ordinary skill in the art would understand that a graphite material comprising sintered meso-carbon micro-beads having the claimed particle size achieves an unexpectedly high charging/discharging efficiency when combined with propylene carbonate.

Accordingly, Applicants respectfully request that the rejection of Claims 26-32 and 35-39 under 35 U.S.C. §103(a) to *MacFadden* and *Ozaki* be withdrawn.

In the Office Action, Claims 26-32 and 35-39 were rejected under 35 U.S.C. §103(a) as being unpatentable over European Patent No. 0724305 B1 to Akashi (“*Akashi*”) in view of *Ozaki*. For at least the reasons set forth below, Applicants respectfully submit that, even if combinable, *Akashi* and *Ozaki* are deficient with respect to independent Claim 26 and Claims 27-32 and 35-39 that depend therefrom.

For example, even if combinable, *Akashi* and *Ozaki* fail to disclose or suggest a gel electrolyte secondary cell including sintered meso-carbon micro-beads having the claimed size in combination with a solvent containing propylene carbonate as required, in part, by Claim 26. As discussed previously, *Ozaki* merely discloses a micro-bead based electrode with a liquid electrolyte and fails to teach the claimed combination of sintered meso-carbon micro-beads having the claimed size and a solvent containing propylene carbonate. See, *Ozaki*, column 2, lines 66-67; column 3, lines 1-7; column 4, lines 54-58; *Affidavit*, ¶ 10. *Akashi* is too general in scope to lead one skilled in the art to the gel electrolyte secondary cell as specifically claimed, when considered in combination with *Ozaki*. For example, as supported by the *Affidavit*, *Akashi* teaches generally using “graphite” as a carbonaceous negative electrode material but in its examples discloses using propylene carbonate with a lithium metal anode. See, *Akashi*, page 5, lines 3-16; page 10, lines 29-40; page 11, lines 1-6; *Affidavit*, ¶ 11. Thus, even if combinable, *Akashi* and *Ozaki* fail to disclose using sintered meso-carbon micro-beads having the claimed size in combination with propylene carbonate in accordance with the present claims.

Moreover, for at least the reasons discussed previously and as supported by the *Affidavit*, a gel electrolyte secondary cell including the claimed combination of sintered meso-carbon micro-beads having the claimed size and a solvent containing propylene carbonate would not have been obvious to one of ordinary skill in the art because the claimed combination achieves unexpected results when combining propylene carbonate with graphite comprising sintered meso-carbon micro beads. See, Specification, Tables 1-2; *Affidavit*, ¶¶ 6-7.

Accordingly, Applicants respectfully request that the rejection of Claims 26-32 and 35-39 under 35 U.S.C. §103(a) to *Akashi* and *Ozaki* be withdrawn.


Applicants further note that Claims 40-41 have been newly added. The new Claims are fully supported in the Specification at, for example, page 3, paragraph 37; page 4, paragraph 52; pages 4-5, paragraph 67. No new matter has been added thereby. Applicants respectfully submit that the subject matter as defined in the newly added claims is patentable over the cited art for at least substantially the same reasons discussed above.

For the foregoing reasons, Applicants respectfully submit that the present application is in condition for allowance and earnestly solicit reconsideration of same.

Respectfully submitted,

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Date: August 9, 2011